

WORKING PAPER

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ABSTRACT

The Consequences of Child Market Work on the Growth of Human Capital⁺

Armand A. Sim^{*}, Daniel Suryadarma[#], and Asep Suryahadi^{*}

Child labor is a phenomenon that has attracted a great amount of attention and research. Theoretical propositions suggest that child labor is inefficient if it adversely affects future potential earning ability. This paper contributes to the literature on the effects of child market work on human capital by focusing on the long-term growth in human capital, which is widely known to significantly affect earning ability. The paper also uses better measures of human capital by focusing on the output of the human capital production function: numeracy skills, cognitive skills, and pulmonary function. Using a rich longitudinal dataset on Indonesia, we find strong negative effects of child labor on the growth of both numeracy and cognitive skills in the next seven years. In addition, we find a strong and negative effect on pulmonary function as measured through lung capacity. Comparing the effects by gender and type of work, we find that female child workers suffer from more adverse effects on their mathematical skills growth, while male child workers experience a much smaller growth in their pulmonary function. We also find that child workers who work for a wage outside the family bear worse effects compared to child workers who work in the family business.

Keywords: child labor, human capital, skills, health, Indonesia

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I. INTRODUCTION

In their theoretical work, Baland and Robinson (2000) state that child labor is inefficient if it adversely affects a child's future earning ability. In addition, Grootaert and Kanbur (1995) note that when child labor displaces schooling and schooling has a positive externality, then child labor is inefficient. These propositions have precipitated much empirical research on the effect of child labor on human capital, with the majority of studies using education attainment or school enrollment as a proxy for human capital (Basu, 1999; Edmonds, 2008).

The use of education attainment or school enrollment as a proxy for human capital has one main weakness. They are measures of input into the human capital production function and do not reflect the output of the production function (Edmonds, 2008; Gunnarsson, Orazem, and Sanchez, 2006). Moreover, in an environment where school quality is low, then input does not usually translate to output (Dumas, 2008). Finally, a number of recent studies find that holding schooling attainment constant, the output of the human capital production function as proxied through test scores has a positive and significant effect on personal income and economic growth (Hanushek and Woessmann, 2008).

A number of studies also examine the effect of child labor on health as the second aspect of human capital. However, some use subjective measures of health such as disruptions to activity due to health conditions (Wolff and Maliki, 2008), or objective measures that are known to be determined early in an individual's life such as height (Beegle, Dehejia, and Gatti, 2009; O'Donnell, Rosati, and van Doorslaer, 2005). Ideally, the health measures used must be objective and could still be affected well into a person's life.

In addition to the difficulties in determining the appropriate outcomes on which the effect of child labor is estimated, the literature has also found different results. Conceptually, the effect of child labor on human capital is ambiguous. On one hand, working can displace schooling. Even in the case where working and schooling go hand-in-hand, the negative effect of working can come through reducing time available for studying, playing, and sleeping (Edmonds and Pacvnik, 2005). On the other hand, child labor may provide the household with sufficient income to keep children in school. Indeed, many studies cited in the literature reviews by Basu (1999) and Edmonds (2008) find zero or positive effect of child labor on school enrollment and education attainment.

Similarly on health, child labor can impart stress on a young body, result in contact with hazardous material, or result in exhaustion (O'Donnell, Rosati, and van Doorslaer, 2005). However, the additional income can be used to maintain the health of children and buy sufficient food. Grootaert and Kanbur (1995) note that if survival depends on work in the informal sector, then the most sensible solution is to take children out of school and put them to work.

In this paper, we estimate the effect of child labor on the accumulation of human capital. Our paper makes several contributions to the literature. First, we measure the effect of child labor on the growth of human capital over a seven-year period, by using a rich longitudinal dataset in Indonesia. Only a few studies in the literature examine the effect of child labor on the growth of human capital (for example O'Donnell, Rosati, and van Doorslaer, 2005), while most can only look at the contemporaneous effect of child labor on human capital due to the general lack of longitudinal datasets in developing countries.

Secondly, we use an objective measure of health that may be directly affected by child labor: pulmonary function as measured through lung capacity. We believe this is a better measure of the potential adverse effects of child labor on health as child workers may be more exposed to low air quality in their workplace and experience irreversible adverse effects on their health, or could experience lower physiological growth due to excessive physical activity.

Thirdly, the data allows us to begin the initial steps in distinguishing the heterogeneous effect of child labor based on whether the work is for wages outside the family or for the family business. This may only address the issue of the human capital effects of hazardous material handling or the worst forms of child labor (Dessy and Pallage, 2005) in a very limited way, but still an important one given the lack of empirical evidence on this particular type of heterogeneity in the literature thus far.

We organize the rest of the paper as follows. The next section describes the datasets used in the paper. Section III discusses child labor in Indonesia, while Section IV outlines the estimation strategy. Section V presents the main estimation results, while sections VI and VII examine gender and type of work heterogeneities respectively. The penultimate section uses working hours as the main independent variable, and the final section concludes.

II. DATA

The first dataset that we use is the National Labor Force Statistics (Sakernas), which is an annual, nationally representative, repeated cross-section, labor force survey that collects activity data of individuals older than 10 years old in the sample households, although the depth of its representativeness varies by year. We use Sakernas to show the share of children aged 10–14 years old who were engaged in market work between 1986 and 2007. Although this is not ideal because Sakernas does not record the activities of individuals younger than 10 years old, it is the only nationally representative dataset that allows us to observe the annual child market work trend in Indonesia over the past two decades.

The second dataset is the Indonesia Family Life Survey (IFLS), a longitudinal household survey that began in 1993. Three full follow-up waves were conducted in, 1997, 2000, and 2007. The first wave represented about 83% of Indonesia's 1993 population, and covered 13 of the nation's 27 provinces. This initial round interviewed roughly 7,200 households. By 2007, the number of households had grown to 13,000 as the survey attempted to re-interview many members of the original sample that formed or joined new households. Household attrition is quite low; only around 5% of households were lost each wave. Overall, 87.6% of households that participated in IFLS1 are interviewed in each of the subsequent three waves (Strauss et al., 2009).

The IFLS added a specific child labor module (B5A-DL4) starting in the 2000 wave. The module is administered to children aged below 15 years old, and records market work both inside and outside of the household. In addition to this, the module records the age at which a child worker began working, hours worked in the past week, and the wage rates of the children who work outside the household.

Child labor has many different definitions. In this paper, we focus on child market work defined as a child who is engaged in economic work in the past month. The definition of economic work is participation in the production of economic goods and services (Edmonds,

2008). Market work can be conducted both inside the household and outside the household. In the case of child workers, market work inside the household is usually unpaid.

Although our main discussion uses the definition of child market work as defined in the previous paragraph, the IFLS allows us to use two other definitions of child market work: any market work from an individual aged between 5 and 14 years old; and market work in the past week. Comparing these two definitions with the one we use, the first is a less firm definition while the second is a firmer definition. Therefore, we expect that the effect of child market work on human capital accumulation would be the smallest if we define child market work using the first alternative definition and the largest if we use the second alternative definition.

The IFLS also conducted mathematics and cognitive tests on children aged 7–14 years old (EK1) and 15–24 years old (EK2). The former contained five numeracy problems and 12 shape matching problems, while the latter contained five numeracy problems and eight shape matching problems.¹ The numeracy problems in EK2 are significantly more complex than those in EK1. These modules were first included in the third wave of the survey in 2000. The identical modules were then re-enumerated to individuals involved in the 2007 survey round. The procedure is as follows. Individuals who had taken the EK1 in the third wave were told to retake the EK1 in the fourth wave. In addition to this, if these individuals were already at least 15 years old in the fourth wave, they were also asked to answer the EK2. Note that these individuals had been aged 7–14 years old in the third wave and were around 14–21 years old in the fourth wave. Similarly, individuals who had answered the EK2 in 2000 were also asked to work on the EK2 in 2007. Finally, the EK1 was administered to individuals who were aged 7–14 years old in 2007. In this paper, we use the EK1 results in 2000 and 2007 for individuals who were first tested in 2000.

To our knowledge, identical mathematics and cognitive tests administered to the same sets of individuals twice in a seven-year period is rare in developing countries. This allows us to go beyond most studies in developing countries by looking at the accumulation of mathematics and cognitive skills among the same individuals over a relatively long period of time.

Finally, the IFLS also measures various health outcomes. In this paper, we use growth in lung capacity, height, and Body Mass Index (BMI) as our health measures. Height growth has been included in a number of studies on child labor (for example Beegle, Dehejia, and Gatti, 2009; O'Donnell, Rosati, and van Doorslaer, 2005), but we believe a better measure is lung capacity, which indicates pulmonary function (Lebowitz, 1991) and respiratory health (He et al., 2010; Rojas-Martinez et al., 2007; Schwartz, 1989).²

III. CHILD MARKET WORK IN INDONESIA

Similar to developing countries in general (Edmonds, 2008), child market work in Indonesia is related to poverty (Kis-Katos and Sparrow, in press; Suryahadi, Priyambada, and Sumarto, 2005). We begin this section by presenting the participation rate in market work for children aged 10–14 years old from 1986 to 2007. The participation rate by gender is shown in Figure 1. The rate for

¹Appendix 1 shows examples of the tests.

²IFLS uses a device called peak flow meter, which measures expiratory flow rate. Expiratory flow rate depends on gender, age, and height, and measures how well the lungs are working (US Department of Health and Human Services, 2007). Peak flow readings are measured in liters per minute.

males was always higher than females throughout the period, and they exhibited the same pattern. After slightly increasing between 1986 and 1989, the child market work participation rate began to decline between 1990 and 1996, during Indonesia's high economic growth period when annual output growth reached close to 7% and the headcount poverty rate declined from 32% to 17% (Suryahadi et al., 2009). During this period, the decline in child market work was around 35% proportionally for males, from 5% to 3.2%, and around 37% proportionally for females, from 3.5 to 2.2%.

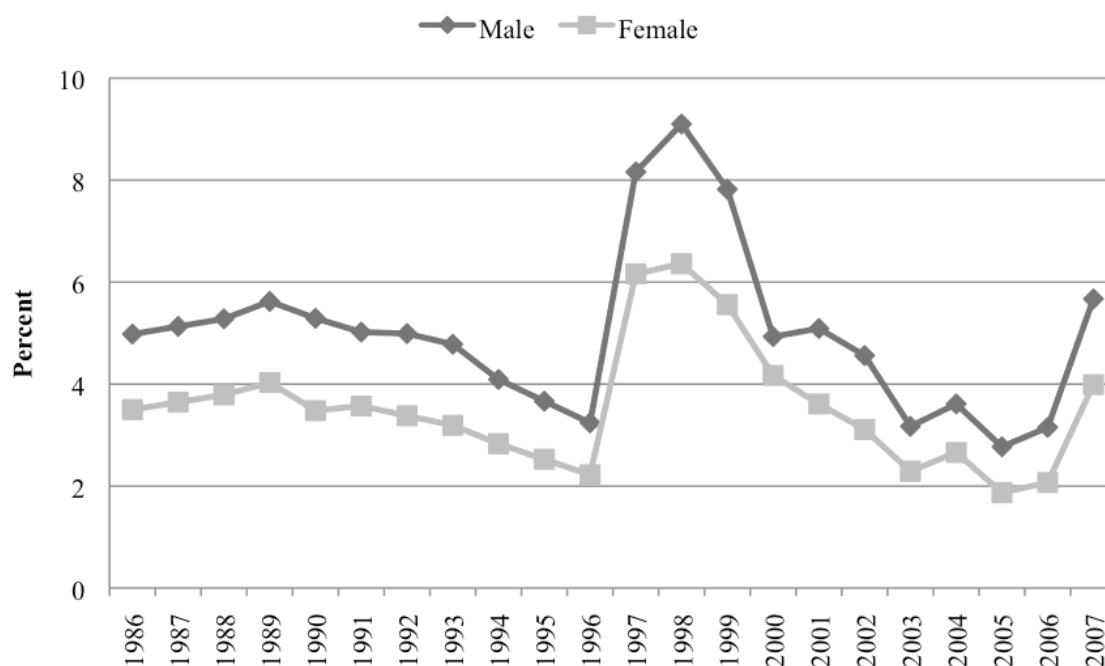


Figure 1. Market work participation rate of 10–14 year-olds, by gender, 1986–2007

Source: Authors' calculation from Sakernas 1986–2007.

The child market work participation rate then soared to 9.1% for males and 6.4% for females during the economic crisis in 1997 and 1998. During the same period, the economy contracted by 14% in 1998 and remained stagnant in 1999 (Strauss et al., 2004) and the headcount poverty rate reached 27% in 1999 (Suryahadi et al., 2009). In addition to the dramatic increase in 1997, another notable change in the market work participation pattern is that the rate of increase between 1996 and 1997 is higher for males than females, as shown by the steeper slope between the two years. This is then accompanied by a greater rate of decrease for males between 1999 and 2000 as the economy recovers.

The child market work participation rate continued to decrease between 2000 and 2006, reaching 2.6%, before dramatically reversing in 2007. While the participation rate in 2006 was lower than in 2000, the rate in 2007 was double the rate in 2006. The explanation for this does not seem to lie in the economy contracting or an increase in adult unemployment, because the economy grew by 6.3% in 2007, higher than in 2006 when growth was 6%, and the adult open unemployment rate was lower in 2007 compared to 2006 (Kong and Ramayandi, 2008).

We turn to the IFLS 2000 and 2007 to explore child market work further. Different from Sakernas, the IFLS's child market work module separates market work by type: inside or outside household, starting age, and also records working hours. Moreover, the IFLS covers children 5–14 years old, allowing for a more comprehensive observation of the extent of child market work in Indonesia.

The distribution of age of entry to market work in 2000 and 2007 is shown in Figure 2, to identify any differences between the two cohorts.³ The average age of entry to market work was about 10.1 years in 2000 and 9.7 in 2007, and the difference is statistically significant. Figure 2 shows that although the median in both cohorts is 10 years old, about 43.6% of child workers in 2007 began working when they were between five and nine years old, while only 36.1% of child workers in 2000 started working between these same ages. Similar to the puzzling increase in child market work participation rate in 2007 as shown in Sakernas, we can observe from the IFLS that child workers in 2007 indeed started working at a younger age, by about five months.



Figure 2. Distribution of age of entry to market work, 2000 and 2007 cohorts

Source: Authors' calculation from IFLS 2000 and 2007.

The pattern is even more puzzling when we consider the year at which the average child worker in the two cohorts began working. The average child worker in 2000 indeed started working in 1997–98, when the economic crisis was at its height. However, the average child worker in 2007 started working in 2004–05, when the economy was performing well. Therefore, the pattern in 2007 is contrary to the common finding that child market work is negatively correlated with economic performance (Edmonds, 2008) and positively correlated with poverty (Suryahadi, Priyambada, and Sumarto, 2005).

We find suggestive explanations for this seemingly contradictory pattern in 2007 by examining two further aspects of child market work. Firstly, we differentiate child market work into whether the work is done within the household for the family business, or outside the household for a wage. Shown in Figure 3 are the child market work participation rates in 2000 and 2007, disaggregated by the two types above. The figure shows that the share of child workers of a given age who were working for a wage in 2007 was much lower than in 2000. On average, 81.4% of child workers in 2000 worked inside the child's own household, while the share was significantly higher in 2007 at 87.4%. In addition, we find that 6.1% of child workers in 2000 were working both inside and outside the household, implying potentially more strenuous work. In contrast, the share of child workers working both inside and outside the household was only 0.8% in 2007.

³Since 5–14 year olds answered the question in both 2000 and 2007, individuals who were 5–7 in 2000 were also in the 2007 sample.

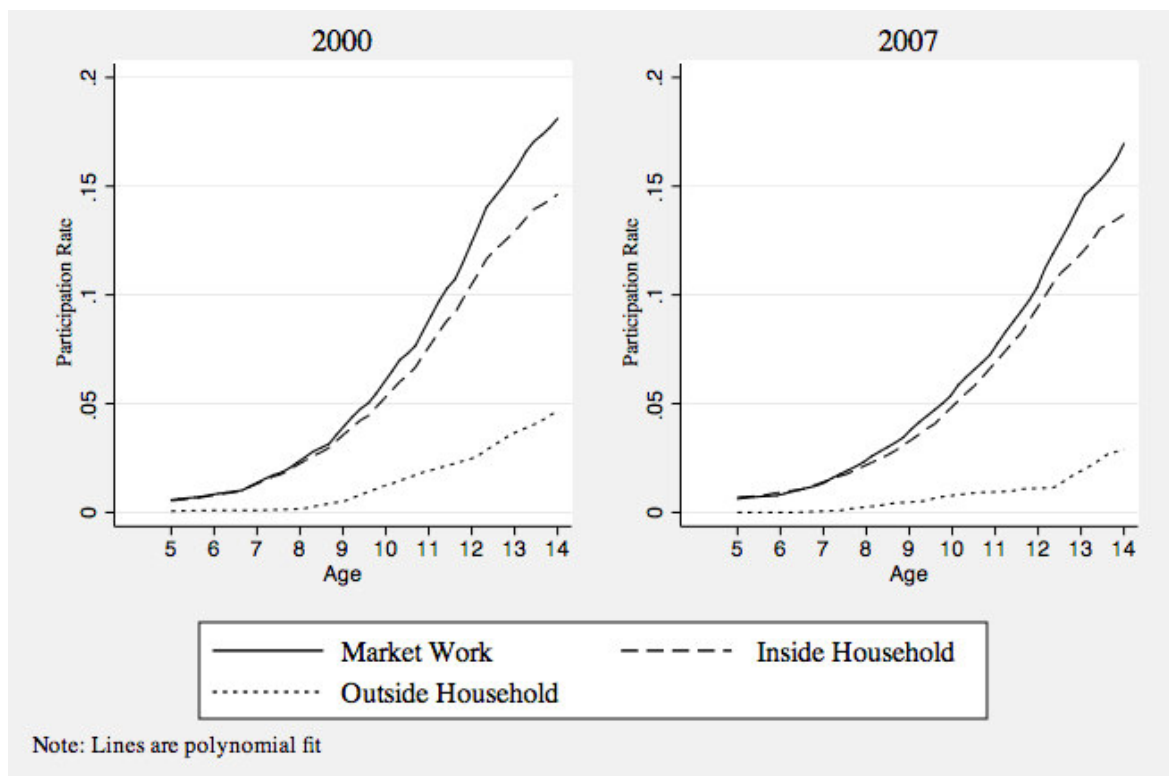


Figure 3. Child market work in 2000 and 2007, by type of work

Source: Authors' calculation from IFLS 2000 and 2007.

The second aspect that we examined is work intensity as measured through working hours per week. Shown in Figure 4 are the working hours for the whole sample, disaggregated by gender, and by the type of work. The figure shows that working hours in 2007 were significantly lower than in 2000 for all sub-samples. The average decline in working hours between the two years is about 36.1% proportionally, while females and males experienced a decline of 34.1% and 37.8% respectively. The smallest decline was in the working hours outside the household, of only 25.3%.

In summary, although the child market work participation rate in 2007 was higher than in 2000 and the child workers in 2007 began working at a younger age, further examination shows that a higher proportion of child workers in 2007 were mostly working solely inside their own household compared to 2000 and only about 1% were working both inside and outside the household. In addition, the child workers in 2007 were working less hours, implying that they were more likely to still be in school and have more time to study compared to child workers in 2000.⁴

⁴Akabayashi and Psacharopoulos (1999) find a trade-off between hours of work and hours of study. A number of studies find a threshold for working hours beyond which schooling and health of the child workers are negatively affected (for example Edmonds and Pacvnik, 2005; Kana, Phoumin, and Seiichi, 2010).



Figure 4. Market work hours, by gender and type, 2000 and 2007 cohorts

Source: Authors' calculation from IFLS 2000 and 2007.

The final issue to be examined is the occupation sector of the child workers. We use information on sectoral share from Sakernas because the IFLS does not record this information. Similar to other developing countries as mentioned in Edmonds and Pavcnik (2005), the majority of child workers in Indonesia are in agriculture (63% in 2000, 62% in 2007). Outside the agricultural sector, the next three sectors that employ the majority of child workers are manufacturing, trade, and other services. Together, these four sectors employed between 96 and 97% of child workers in 2000 and 2007.

Although the occupation sector share of child workers appears to be relatively constant between 2000 and 2007, we observe considerable heterogeneity in the pattern by gender. In Figure 5A the distribution of child workers by gender in 2000 and 2007 in agriculture, manufacturing, and trade can be seen. The share of male child workers in agriculture is significantly higher than the share of female child workers in the sector. The gap was around 15 percentage points in 2000 and has since widened to 25 percentage points by 2007 as female child workers move out of agriculture and male child workers move into agriculture. In contrast, there are significantly more female child workers in manufacturing and trade. The share of female child workers in both sectors was almost double that of male child workers in 2000, with this gap widening slightly by 2007. Different from the contrasting gender pattern in agriculture, it appears that both female and male child workers' participation in the manufacturing sector slightly declined, while their participation in trade increased.

The pattern is more striking when we examine the rest of the occupation sectors, as shown in Figure 5B. The largest increase took place in the other services sector, which includes occupations like domestic helper.⁵ In 2000, about 2% and 3.4% of male and female child workers respectively were working in this sector. By 2007, the share of male child workers reached 2.8% while the share of female child workers almost tripled to 9.1%. On the other hand, the share of male child workers in the other occupations declined between 2000 and 2007, while the share of female child workers increased in all other sectors except construction.

⁵Formally, Statistics Indonesia includes the following occupations in the other services: government, education, health, social work, international agencies, and domestic duties.

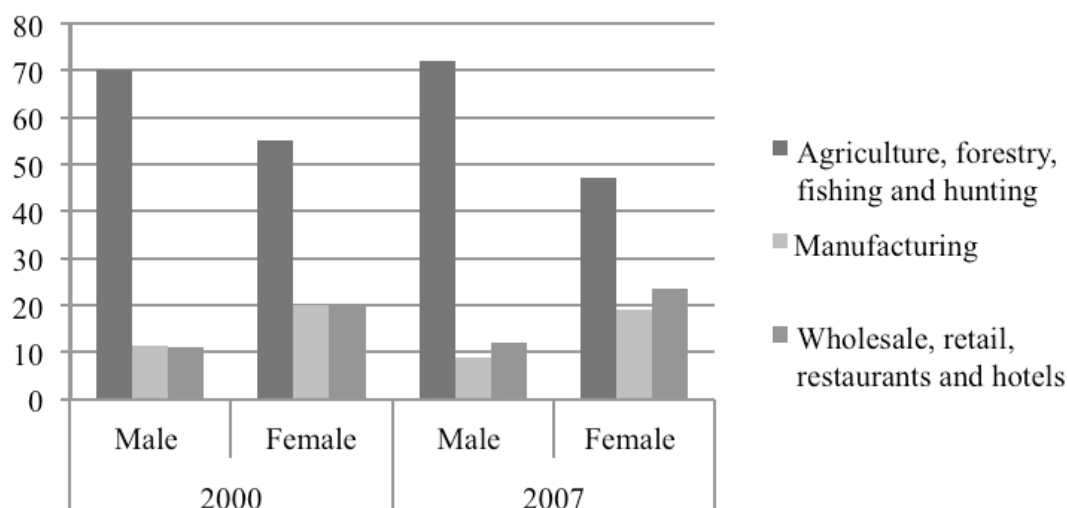


Figure 5A. Three most popular occupation sectors of child workers 2000 and 2007, by gender

Source: Authors' calculation from Sakernas 2000 and 2007.

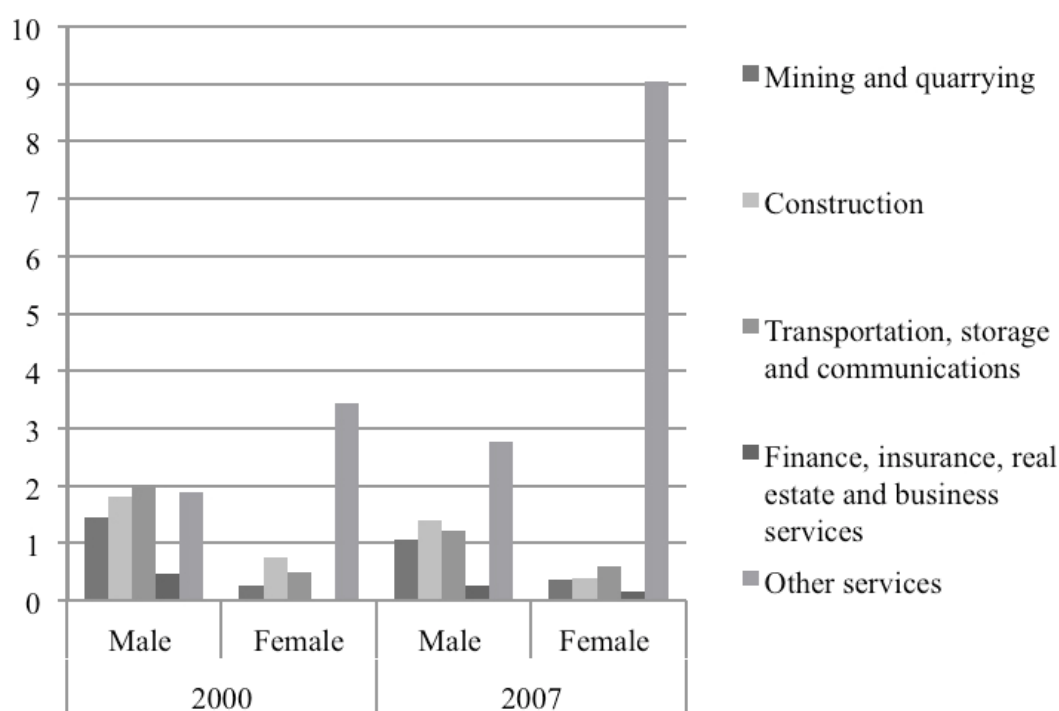


Figure 5B. The rest of occupation sectors of child workers 2000 and 2007, by gender

Source: Authors' calculation from Sakernas 2000 and 2007.

Linking the information of occupation sectors to strenuous and hazardous work, the fact that the higher participation rate of male child workers in construction and mining sectors may imply that male child workers would be more susceptible to lower growth in health conditions than female child workers. In addition, it may also be possible that the kind of work that male and female child workers are engaged in is different even though they are in the same occupation sector. In any case, these observations indicate the possibility of gender heterogeneity in the effect of child labor on human capital growth.

To conclude, we find that child market work participation rate in Indonesia, annually averaging 4.3% between 1986 and 2007, is smaller than most developing countries listed in Edmonds (2008). In addition, although working hours in Indonesia were similar to developing country averages calculated by Edmonds and Pacvnik (2005) in 2000, the hours have since significantly dropped and by 2007, the average child worker in Indonesia spent about 11 hours per week working.

Despite the low child market work participation rate in Indonesia, more than 2.7 million children between 5 and 14 were engaged in market work in 2007. In addition, those who were working outside the household on average devote close to 20 hours per week to working. Therefore, the empirical question of whether child market work has any significant effects on human capital accumulation remains important.

IV. ESTIMATION STRATEGY

Given our focus on the effect of market work on the growth in skills and health conditions between 2000 and 2007, our main child worker sample consists of those who were engaging in market work in 2000 while the comparison group are those who were not working in 2000. The base econometric specification is shown in Equation 1:

$$\frac{Y_{i,2007} - Y_{i,2000}}{\sigma_{2000}} = f(W_{i,2000}, X_i, P_i, H_{j,2000}, \epsilon_i) \quad (1)$$

Where the dependent variable is the difference in individual i 's outcomes of interest (mathematics skills, cognitive skills, lung capacity, height, and BMI) between 2000 and 2007, divided by the standard deviation of each particular outcome for the sample in 2000. Our main independent variable is $W_{i,2000}$, the working status of the individual in 2000, which is equal to one if the individual had worked in 2000 and zero otherwise. In addition to a binary variable of child market work, we also use working hours per week as an alternative independent variable. We discuss the results for the latter in the penultimate section.

The control variables include X_i , a vector that consists of individual characteristics such as age, gender, location of residence, and education attainment in 2007⁶; P_i , parental education attainment as measured through years of completed schooling; and $H_{j,2000}$, household conditions in 2000 such as value of assets and total household expenditure.

As is already widely discussed in the literature on child labor, estimating an Ordinary Least Squares (OLS) on Equation 1 usually produces biased estimates. Studies in the literature (for example Akabayashi and Psacharopoulos, 1999; Beegle, Dehejia, and Gatti, 2009; Gunnarsson, Orazem, and Sanchez, 2006; Kana, Phoumin, and Seiichi, 2010; O'Donnell, Rosati and van Doorslaer, 2005; Wolff and Maliki, 2008; more studies mentioned in Edmonds, 2008) use various instrumental variables such as household land holdings, the local economy, prices, or labor market conditions, school quality and availability, and compulsory school starting age.

⁶We control for education attainment in 2007 in order to ensure that the effect of child labor on skills accumulation does not come through lower education attainment.

In this paper, we use an instrument that to our knowledge has not been attempted before: provincial-legislated minimum wage levels. The choice to use minimum wage levels as a measuring instrument is motivated by Basu (2000), whose theoretical work finds that minimum wage changes have the potential to directly affect the extent of child labor. In addition, the process of determining the minimum wage in Indonesia is conducted in such a way that we have no reason to suspect that it may influence our research outcomes through other channels; that is to say beyond its influence on the decision to send a child to work.

According to Suryahadi et al. (2003), the minimum wage in Indonesia is calculated based on a bundle of consumption items deemed essential for the livelihood of a single worker, around 2,600 to 3,000 calories per day. Until the end of 2000, each province had a single minimum wage level, determined through a tripartite discussion process attended by employee representatives, employers, and the government. Therefore, the level of the legislated minimum wage is the result of province-specific conditions and the between-province variation in minimum wages reflects the variation in prices and negotiation results.

Our instrumental variable specification is then:

$$W_{i,2000} = g(MW_p, X_i, P_i, H_{j,2000}, v_i) \quad (2)$$

$$\frac{Y_{i,2007} - Y_{i,2000}}{\sigma_{2000}} = f(\hat{W}_{i,2000}, X_i, P_i, H_{j,2000}, \epsilon_i) \quad (3)$$

Where MW_p is the legislated minimum wage in province p . Since the IFLS provides information on the year that each child worker began working, we match the minimum wage level in the particular year and province where the child worker began working. The majority of child workers in our sample, 79%, began working between 1997 and 1999, at the height of the economic crisis in Indonesia. For the non-child workers, we assign the minimum wage values according to their province of residence and predicted year that they would have begun working, based on their birth year.⁷

4.1 Summary Statistics

The summary statistics are shown in Table 1. Child workers appear to perform significantly better in mathematics and cognitive tests in 2000 compared to non-child workers, but the latter have either caught up to, or surpassed the former, in 2007. In other words, the child workers experienced slower growth in mathematics and cognitive skills. In terms of health, child workers were significantly taller in both 2000 and 2007, while there was no difference in BMI in 2007 between child workers and non-workers. Finally, the unconditional comparison of lung capacity shows that child workers had a significantly larger lung capacity in 2007 compared to non-child workers.

Among the independent variables, we observe no difference in education attainment in 2007 between child workers and non-workers. In fact, the child workers appeared to be able to reduce the unconditional gap in the education attainment levels of around 0.5 years in 2000. This supports the finding of Suryahadi, Priyambada, and Sumarto (2005) that child market work may have a positive effect on education attainment levels in Indonesia. In contrast, both

⁷We predict the year for non-child workers by regressing the year started working on the birth year of the child workers, and then use the estimated coefficient to predict the starting year that the non-child workers would have begun working had they been sent to work.

the father and mother of child workers have significantly lower education attainment levels than the parents of the non-child workers, although the gap of around 0.4 years is relatively small. In terms of expenditure and assets, we observed no difference in the total expenditure of households where the child workers live compared to those of non-child workers, although households where the non-child workers live have significantly higher asset values. Finally, a higher proportion of child workers live in rural areas compared to non-child workers.

Table 1. Summary Statistics

Variables	Full Sample			Children not working in 2000			Children working in 2000			Mean Difference Significant at 5%
	N	Mean	Std. Dev	N	Mean	Std. Dev	N	Mean	Std. Dev	
Skills and Health Outcomes										
Mathematics Score in 2000	3905	2.7	1.5	3582	2.7	1.5	323	2.9	1.4	Yes
Mathematics Score in 2007	3905	3.0	1.4	3582	3.1	1.4	323	2.9	1.4	Yes
Cognitive Score in 2000	3905	7.6	3.3	3582	7.5	3.3	323	7.9	3.2	Yes
Cognitive Score in 2007	3905	9.4	3.0	3582	9.4	2.9	323	9.1	3.3	No
Lung Capacity in 2000 (l/min)	2497	219.5	62.1	2226	216.9	60.8	271	241.3	68.1	Yes
Lung Capacity in 2007 (l/min)	3505	322.8	94.5	3215	321.7	94.0	290	335.3	98.7	Yes
Height in 2000 (m)	3615	1.3	0.1	3315	1.3	0.1	300	1.4	0.1	Yes
Height in 2007 (m)	3512	1.6	0.1	3219	1.6	0.1	293	1.6	0.1	Yes
BMI in 2000 (kg/sqm)	3601	15.9	2.6	3301	15.8	2.5	300	16.9	3.2	Yes
BMI in 2007 (kg/sqm)	3423	21.4	39.0	3135	21.4	40.6	288	21.3	12.4	No
Independent Variables										
Child Labor Status (=1)	3905	0.1	0.3	3582	0.0	0.0	323	1.0	0.0	
Economic Work (=1)	3905	0.0	0.1	3582	0.0	0.0	323	0.2	0.4	
Family Business Work (=1)	3900	0.1	0.2	3582	0.0	0.0	318	0.8	0.4	
Working Hours per week	3905	1.3	7.5	3582	0.0	0.0	323	15.7	21.4	
Age in 2007	3905	17.4	2.4	3582	17.3	2.3	323	19.1	2.1	Yes
Years of Schooling in 2000	3905	5.2	2.3	3582	5.3	2.3	323	4.8	2.2	Yes
Years of Schooling in 2007	3905	9.1	2.8	3582	9.1	2.7	323	9.1	3.2	No
Male (=1)	3905	0.5	0.5	3582	0.5	0.5	323	0.6	0.5	No
Years of Schooling of Father in 2000	3905	5.1	2.3	3582	5.1	2.3	323	4.7	2.1	Yes
Years of Schooling of Mother in 2000	3905	5.2	2.3	3582	5.2	2.3	323	4.8	2.1	Yes
Number of Boys Aged 0 to 5	3559	0.5	0.6	3251	0.5	0.6	308	0.4	0.6	Yes
Number of Boys Aged 6 to 9	3559	0.5	0.6	3251	0.5	0.6	308	0.5	0.6	Yes
Number of Boys Aged 10 to 14	3559	0.5	0.6	3251	0.5	0.6	308	0.6	0.7	Yes
Number of Boys Aged 15 to 17	3559	0.2	0.4	3251	0.2	0.4	308	0.2	0.5	No
Log of Total Expenditure in 2000	3905	13.8	0.7	3582	13.8	0.7	323	13.9	0.7	No
Log of Total Household Assets in 2000	3905	16.3	1.6	3582	16.3	1.6	323	16.1	1.6	Yes
Urban (=1)	3905	0.4	0.5	3582	0.5	0.5	323	0.4	0.5	Yes

Source: Authors' calculation from IFLS 2000 and 2007.

V. ESTIMATION RESULTS

We followed the studies mentioned in the previous section by assuming child market work to be endogenous. Therefore, we have focused on the two-stage least squares (2SLS) estimation results as shown in Table 2. The estimation results using the two alternative definitions discussed in Section II are shown in Appendix 2, while the OLS estimation results are shown in Appendix 3. It is important to note three issues. Firstly, the instrument performs strongly, as shown through the large first-stage F statistics. Secondly, comparing the OLS with the 2SLS estimation results, we find the effect of child market work to be larger when market work is considered as endogenous, implying that the OLS results are underestimated. This is consistent with the findings of Gunnarsson, Orazem, and Sanchez (2006). Thirdly, Table 2 and Appendix 2 show that the effects of child market work on human capital accumulation becomes larger as we move from the loosest to the firmest definition of child market work.

We find that children who were engaged in market work in 2000 experienced around one standard deviation lower growth in mathematics skills compared to children who were not engaged in market work in 2000. The effect is especially substantial when measured in years of schooling. According to Suryadarma (2010), one additional year of schooling in Indonesia increases mathematics skills by about 0.13 standard deviations. Therefore, the effect of child market work on mathematics skills accumulation is worth about 7.7 years of schooling. Given that the time period in our study is seven years, the results practically imply that the child workers did not experience any growth in mathematics skills between 2000 and 2007.

The effect on child market work on cognitive skills growth is similarly large relative to the effect on mathematics skills growth, of about 1.1 standard deviations. Therefore, we find that holding education attainment constant, engaging in market work significantly reduces a child's mathematics and cognitive skills growth, and that the effects on these two skills are similarly large. Given that we are controlling the years of schooling in 2007, the effect of child market work on skills growth could happen through less hours available for studying, which happens in Tanzania (Akabayashi and Psacharopoulos, 1999). Unfortunately, we have no data on time use and as such are unable to investigate whether this is the case in Indonesia.

Looking at the health effects of child market work, meanwhile, we find that the only health measure that is significantly affected is lung capacity. The insignificant effect of child market work on height growth and BMI growth supports results from Vietnam (Beegle, Dehejia, and Gatti, 2009; O'Donnell, Rosati, and van Doorslaer, 2005). In contrast, growth in lung capacity among child workers between 2000 and 2007 is 1.4 standard deviations lower than non-child workers, which is a very large effect. Based on the literature on child lung function growth (He et al., 2010), the results indicate that child workers may be working in environments with higher air pollution, resulting in lower respiratory health compared to non-child workers. If this health effect is irreversible later in life, then the associated health costs, or the loss from early mortality resulting from market work, may be substantial.⁸

⁸In a study in the United States, Evans and Smith (2005) find that the long-term effects of exposure to air pollution include heart attack and angina.

Table 2. The Effect of Child Market Work on Human Capital Accumulation, 2SLS Results

	Mathematics Skills Growth		Cognitive Skills Growth		Lung Capacity Growth		Height Growth		BMI Growth	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Child Labor Status (=1)	-0.998***	0.329	-1.146***	0.373	-1.357***	0.312	0.068	0.203	2.248	1.581
Years of Schooling in 2007	0.021**	0.008	0.017*	0.010	0.004	0.006	0.002	0.003	0.011	0.009
Male (=1)	-0.086**	0.035	-0.054	0.040	0.883***	0.028	0.245***	0.011	-0.023	0.042
Urban (=1)	-0.145***	0.038	-0.177***	0.042	0.017	0.032	0.006	0.012	0.016	0.067
Age of Respondents in 2007	-0.807***	0.116	-0.685***	0.139	0.744***	0.133	0.060**	0.027	-0.156	0.190
Age of Respondents in 2007 Squared	0.020***	0.003	0.016***	0.004	-0.022***	0.003	-0.006***	0.001	0.004	0.005
Mother's Education (years)	0.030	0.046	0.034	0.051	-0.024	0.036	-0.016	0.014	-0.017	0.027
Father's Education (years)	-0.087*	0.046	-0.099*	0.051	-0.011	0.036	0.016	0.014	0.022	0.031
Total Expenditure (Log)	-0.023	0.034	0.002	0.039	0.072***	0.027	-0.005	0.011	-0.055	0.057
Household Asset (Log)	0.004	0.014	-0.020	0.016	0.004	0.011	-0.002	0.004	0.019	0.018
Number of observations	3,903		3,903		3,091		5,422		5,323	
R-Squared	0.047		0.043		0.296		0.650		-0.109	
First-stage F Statistics	25.61		25.61		21.18		28.80		24.11	

Note: ***1% significant

**5% significant

*10% significant

White-Huber robust standard errors were computed. The instrumental variable used is provincial minimum wage in the year that a child worker began working or a non-child worker is predicted to have begun working.

VI. GENDER HETEROGENEITY

We do not observe significant gender differences in terms of the child market work participation rate, the type of work as reflected in the place of employment, or, among the child workers working hours, in 2000. However, we may still see gender heterogeneity in the effects of child market work due to other reasons, such as their participation in different tasks (Edmonds, 2008). The estimation results of the effect of child market work when the sample is separated by gender is shown in Table 3.

The estimation results show that female child workers experience a larger negative effect on mathematics skills growth than male child workers by as much as an additional 0.4 standard deviations. Although the sizes of the standard errors imply that the gender difference may not be statistically significant, the size of the effect remains substantial.

In addition, we also observe large and statistically significant gender heterogeneity in the effect of child market work on lung capacity growth. Male child workers have approximately two standard deviations lower growth compared to male non-child workers in terms of lung capacity between 2000 and 2007. In contrast, the effect of child market work on female child workers' lung capacity growth is 0.7 standard deviations. Since smaller lung capacity is associated with higher air pollution and more inferior respiratory condition, the results suggest that male child workers may be working in generally worse environmental conditions than female child workers.

VII. TYPE OF WORK HETEROGENEITY

Heterogeneity in the effects of child market work can also take place between child workers who work inside their household and those who work outside their household. As an example, the child workers who are working for their parents, although unpaid, may not work as intensely as those who are working for a wage outside the household.⁹ Although working hours are only an indirect measure of work intensity, Figure 4 shows a gap of nearly 11 hours per week between child workers who work in their family business and those who work for a wage in 2000.

In this section, we examine whether the type of work heterogeneity in terms of the effect of child market work on human capital accumulation exists. However, we are somewhat constrained by the small sample size of child workers who are working for a wage, because 81% of the child workers in our sample were working in the family business. Due to the small sample size, there is not enough variation in the child labor status (the comparison group in each estimate consists of non-child workers) and, as such, the instrument variable does not perform as strongly as in the other results. In addition, we do not explicitly model the decision to work inside or outside the household. To the extent that the decision is related to the outcomes that we are measuring and have no controls for, then the estimation results may be inconsistent.

⁹The assumption that working for wage outside the household is worse than working for the family business may or may not be true. As an example, injury rate from child market work in agriculture—which may include working in family-owned land—is higher than the injury rate in child market work in manufacturing—which most likely falls under working for wage (Ashagrie, 1998). However, most of the worst forms of child labor as discussed in ILO (2002), such as bonded labor, prostitutes, soldiers, or involvement in pornography, are done outside the household.

Table 3. The Effect of Child Market Work on Human Capital Accumulation, by Gender, 2SLS Results

	Mathematics Skills Growth		Cognitive Skills Growth		Lung Capacity Growth		Height Growth		BMI Growth	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
MALE										
Child Labor Status (=1)	-0.824**	0.400	-1.158**	0.479	-1.971***	0.510	0.237	0.241	0.882	0.985
Number of observations	2,118		2,118		1,644		2,862		2,816	
R-Squared	0.061		0.051		0.024		0.602		-0.018	
First-stage F Statistics	18.5		18.5		12.6		13.88		13.95	
FEMALE										
Child Labor Status (=1)	-1.234**	0.566	-1.042*	0.578	-0.654**	0.326	-0.150	0.330	3.736	3.181
Number of observations	1,785		1,785		1,447		2,560		2,507	
R-Squared	0.016		0.051		0.176		0.718		-0.244	
First-stage F Statistics	10.49		12.60		11.44		13.15		12.83	

Note: ***1% significant

**5% significant

*10% significant

White-Huber robust standard errors were computed. The instrumental variable used is provincial minimum wage in the year that a child worker began working or a non-child worker is predicted to have begun working. All control variables are included in the estimation, but not shown for brevity.

Table 4. The Effect of Child Market Work on Human Capital Accumulation, by Type of Work, 2SLS Results

	Mathematics Skills Growth		Cognitive Skills Growth		Lung Capacity Growth		Height Growth		BMI Growth	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
FAMILY BUSINESS										
Child Labor Status (=1)	-1.455***	0.499	-1.706***	0.558	-1.427***	0.338	0.041	0.197	1.286	0.936
Number of observations	3,815		3,815		2,221		4,303		4,228	
R-Squared	0.010		0.003		0.240		0.531		-0.039	
First-stage F Statistics	15.350		15.350		11.36		17.10		17.10	
FOR WAGE										
Child Labor Status (=1)	-3.446***	1.000	-3.252***	1.084	-3.064***	0.871	-0.022	0.425	3.011	2.258
Number of observations	3,628		3,628		2,077		4,133		4,060	
R-Squared	-0.034		-0.003		0.195		0.531		-0.047	
First-stage F Statistics	5.910		5.910		4.510		4.820		4.720	

Note: ***1% significant

**5% significant

*10% significant

White-Huber robust standard errors were computed. The instrumental variable used is provincial minimum wage in the year that a child worker began working or a non-child worker is predicted to have begun working. All control variables are included in the estimation, but not shown for brevity.

Table 5. The Effect of Child Market Working Hours on Human Capital Accumulation, 2SLS Results

	Mathematics Skills Growth		Cognitive Skills Growth		Lung Capacity Growth		Height Growth		BMI Growth	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Working hours per week in 2000	-0.056***	0.021	-0.064***	0.024	-0.100***	0.028	0.004	0.012	0.136	0.100
Years of Schooling in 2007	0.011	0.010	0.006	0.012	-0.011	0.010	0.002	0.004	0.026	0.020
Male (=1)	-0.103***	0.037	-0.074*	0.042	0.844***	0.035	0.246***	0.012	0.015	0.046
Urban (=1)	-0.120***	0.039	-0.148***	0.043	0.060*	0.036	0.005	0.012	-0.022	0.059
Age of Respondents in 2007	-0.856***	0.129	-0.742***	0.154	0.836***	0.175	0.060**	0.028	-0.158	0.196
Age of Respondents in 2007 Squared	0.021***	0.004	0.018***	0.004	-0.025***	0.004	-0.006***	0.001	0.004	0.005
Mother's Education (years)	0.035	0.047	0.040	0.052	-0.011	0.040	-0.016	0.014	-0.023	0.032
Father's Education (years)	-0.089*	0.047	-0.101*	0.052	-0.018	0.040	0.016	0.014	0.024	0.034
Total Expenditure (Log)	-0.019	0.036	0.006	0.041	0.076**	0.032	-0.005	0.012	-0.060	0.062
Household Asset (Log)	0.011	0.014	-0.011	0.017	0.009	0.013	-0.002	0.004	0.006	0.014
Number of observations	3,903		3,903		3,091		5,422		5,323	
R-Squared	-0.040		-0.049		0.029		0.649		-0.290	
First-stage F Statistics	11.740		11.740		10.320		12.010		11.760	

Note: ***1% significant

**5% significant

*10% significant

White-Huber robust standard errors were computed. The instrumental variable used is provincial minimum wage in the year that a child worker began working or a non-child worker is predicted to have begun working.

However, we believe that this is an important, yet largely unexplored, aspect in the research on the effect of child labor. Therefore, we still present these results in Table 4. We find that the effect of child market work is different based on the type of work that the child is engaged in. The results on growth in mathematics skills, cognitive skills, and lung capacity suggest that working for a wage has a much more severe negative effect on the human capital accumulation of child workers. Comparing the coefficients, the effects of working for a wage are about twice as severe as the effects of working in the family business.

VIII. WORKING INTENSITY

An indicator of market work participation masks the effect of different work intensity. For this reason, many studies that examine the effects of child labor also use working hours as their main independent variable.¹⁰ In our research we use working hours per week as the indicator of child market work, and the results are shown in Table 5. Although a number of studies have included a more flexible form of working hours (for example Kana, Phoumin, and Seiichi, 2010), we only use the linear form in order to avoid complicating the instrumental variables procedure.

The results continue to show significant and negative effects on the growth of mathematics skills, cognitive skills, and lung capacity. In addition, there is no effect on height growth or BMI growth. One additional hour per week of market work in 2000 results in a 0.06 lower standard deviation of mathematics and cognitive skills growth, and a 0.1 standard deviation lower lung capacity growth.

IX. CONCLUSION

Child labor is a phenomenon that has attracted a great amount of attention and research. Theoretical propositions suggest that child labor is inefficient if it adversely affects future earning ability. We contribute to the literature on the effects of child market work on human capital by focusing on the long-term growth in human capital. We also use better measures of human capital by focusing on the output of the human capital production function: numeracy skills, cognitive skills, and pulmonary function.

After controlling education attainment levels, we find a strong negative effect on child labor in terms of the growth of both numeracy and cognitive skills in the next seven years. Comparing these effects, it appears that the negative effects of child labor on these important skills are similarly large. In addition, we also find a strong and negative effect on pulmonary function as measured through lung capacity.

¹⁰Some studies use tobit in the first stage, but we prefer to continue using OLS to keep the first stage estimation simple. In any case, estimating an OLS on data that is censored at zero provides consistent estimates.

Differentiating the effects by gender, we find that the adverse effect of child labor on the growth in mathematics skills for females is larger. We also find that male child workers experience a much smaller growth in pulmonary function. The latter implies that male child workers may be working in areas with higher levels of air pollution. We also investigated whether the effects are different based on the type of work. We indeed find that children who were working for a wage outside the family in 2000 had a much lower growth in skills and pulmonary function by 2007 in comparison to children who were working in the family business. Based on the estimation results in Section VIII, a channel where some of these larger adverse effects come through may be the longer working hours of the child workers who were working outside the household.

In closing, while many studies find no effect or even a positive effect of child labor on the input to the human capital production function of the child workers, our focus on the output of the production function unearths strong and large negative effects. Our results also imply that the effects of child labor on human capital accumulation may be much worse in other developing countries poorer than Indonesia, where a higher share of children are working and those child workers are working for a wage in factories or other locations outside the household. Therefore, child labor remains a phenomenon that needs to be seriously addressed by policymakers in developing countries. In particular, the first priority should be the elimination of cases of child labor occurring outside the household.

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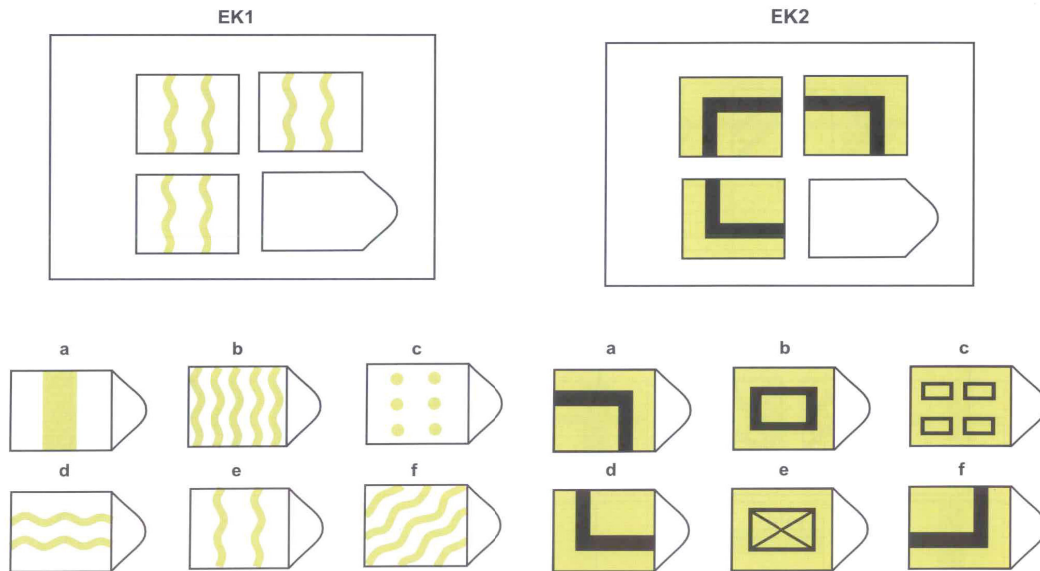
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APPENDICES

Appendix 1. Cognitive and Numeracy Test Examples from IFLS



EK13. $49 - 23 = \dots$

- a. 25
- b. 26
- c. 27

EK14. $267 + 112 - 189 = \dots$

- a. 180
- b. 188
- c. 190

EK15. $(8 + 9) * 3 = \dots$

- a. 34
- b. 45
- c. 51

EK16. $56/84 = \dots$

- a. $4/7$
- b. $2/3$
- c. $3/4$
- d. $5/6$

EK17. $1/3 - 1/6 = \dots$

- a. $2/3$
- b. $1/3$
- c. $1/6$
- d. $1/9$

Appendix 2. The Effect of Child Market Work on Human Capital Accumulation, Alternative Definitions of Child Market Work, 2SLS Results

	Mathematics Skills Growth		Cognitive Skills Growth		Lung Capacity Growth		Height Growth		BMI Growth	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
LOOSEST CHILD MARKET WORK DEFINITION										
Any Child Market Work (=1)	-0.878***	0.296	-1.027***	0.338	-1.146***	0.264	-0.014	0.176	1.943	1.365
Number of observations	3,905		3,905		3,109		5,426		5,329	
R-Squared	0.053		0.048		0.312		0.659		-0.094	
First-stage F Statistics	31.150		31.150		26.120		29.210		29.080	
FIRMEST CHILD MARKET WORK DEFINITION										
Child Market Work in the Past Week (=1)	-1.153***	0.397	-1.350***	0.457	-1.446***	0.342	-0.018	0.225	2.500	1.764
Number of observations	3,905		3,905		3,109		5,426		5,329	
R-Squared	0.030		0.025		0.287		0.659		-0.124	
First-stage F Statistics	20.850		20.850		19.270		22.720		22.680	

Note: ***1% significant
 **5% significant
 *10% significant

White-Huber robust standard errors were computed. The instrumental variable used is provincial minimum wage in the year that a child worker began working or a non-child worker is predicted to have begun working. All control variables are included in the estimation, but not shown for brevity.

Appendix 3. The Effect of Child Market Work on Human Capital Accumulation, OLS Results

	Mathematics Skills Growth		Cognitive Skills Growth		Lung Capacity Growth		Height Growth		BMI Growth	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Child Labor Status (=1)	-0.035	0.059	0.005	0.071	-0.073	0.045	-0.071***	0.026	-0.050	0.035
Years of Schooling in 2007	0.026***	0.008	0.024**	0.010	0.009*	0.005	0.001	0.003	0.002	0.005
Male (=1)	-0.086**	0.034	-0.052	0.038	0.894***	0.025	0.245***	0.011	-0.036	0.043
Urban (=1)	-0.125***	0.037	-0.153***	0.040	0.050*	0.028	0.004	0.012	-0.009	0.057
Age of Respondents in 2007	-0.767***	0.112	-0.626***	0.136	0.339***	0.087	0.074***	0.017	0.076	0.051
Age of Respondents in 2007 Squared	0.018***	0.003	0.013***	0.004	-0.012***	0.002	-0.006***	0.000	-0.002	0.002
Mother's Education (years)	0.035	0.044	0.038	0.049	-0.021	0.032	-0.018	0.014	-0.029	0.025
Father's Education (years)	-0.081*	0.045	-0.091*	0.049	-0.003	0.033	0.017	0.014	0.021	0.027
Total Expenditure (Log)	-0.053*	0.031	-0.038	0.036	0.030	0.023	-0.001	0.010	-0.006	0.025
Household Asset (Log)	0.010	0.013	-0.012	0.016	0.013	0.010	-0.003	0.004	0.010	0.011
Number of observations	3,917		3,917		3,100		5,432		5,333	
R-Squared	0.102		0.104		0.426		0.652		0.001	

Note: ***1% significant

**5% significant

*10% significant

White-Huber robust standard errors were computed.